AUTO-BALACING TRANSPORTATION DEVICE WITH STABLE PLATFORM PIVOT AXES

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims the benefit of provisional application no. 62/790,339, filed Jan. 9, 2019, entitled Foot Support Hinge Inside Wheel Envelope for Personal Vehicles, and having Ywanne Ying Chen as inventor.

FIELD OF THE INVENTION

[0002] The present invention related to central wheel structure auto-balancing transportation devices and, more specifically, to such devices with foldable foot platforms.

BACKGROUND OF THE INVENTION

[0003] The prior art includes several auto-balancing transportation devices. These include the Segway, developed by Kamen et al and disclosed in U.S. Pat. No. 6,302,230 (among others), the Solowheel, by Chen (U.S. Pat. No. 8,807,250) and Hovertrak, also by Chen (U.S. Pat. No. 8,738,278). These three patents are hereby incorporated by reference as though disclosed in their entirety herein.

[0004] FIG. 1 shows a prior art auto-balancing device 10. Device 10 may include a wheel structure 20 with two tires 21,31, a first foot platform and a second foot platform 22,32, a motor (obscured from view) which drives the wheel structure, a position sensor 16 (which may be gyroscopic or other) and a control circuit 18. Data from the position sensor is used by the control circuit to drive the motor towards dynamically self-balancing the device.

[0005] The foot platforms 22,32 can pivot between an in-use position and a stowed position at axis 41,42, respectively. In the in-use position (shown in FIG. 1), the foot platforms extend laterally outward from the sides of wheel structure so that the wheel structure is between the rider's legs. In the stowed position, the foot platforms are folded up, vertically flush with the remainder of the housing 51. The pivot axes 41,42 of the foot platforms are oriented parallel to the direction of travel of the device. In the prior art, the pivot axes are located outwardly of the tires and the housing 51.

[0006] A problem exists with this device during mount and dismount. The device is typically mounted one foot at a time. When a foot is placed on a platform, the weight of the rider is transferred to the foot platform and its pivot axis. The downward force at the axis and its position outside of the wheel structure causes the wheel structure to tip, as shown in FIG. 2. In this position, it is difficult to mount the device. The second foot platform is in an awkward position and the device is unstable. Further, the device may tip over all the way, landing on a rider's foot.

[0007] A need exits for an easier and more controllable mount and dismount of this type of auto-balancing device.

SUMMARY OF THE INVENTION

[0008] Accordingly, it is an object of the present invention to overcome the shortcomings of the prior art.

[0009] It is another object of the present invention to provide an auto-balancing device with a platform and wheel structure arrangement that is more stable and makes mount and dismount easier and safer.

[0010] It is also an object of the present invention to provide such a device in which the platform pivot axes are within the wheel structure.

[0011] These and related objects of the present invention are achieved by use of an auto-balacing transportation device with more stable platform pivot axes as described herein.

[0012] The attainment of the foregoing and related advantages and features of the invention should be more readily apparent to those skilled in the art, after review of the following more detailed description of the invention taken together with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIGS. 1-2 are a perspective view and a front elevation view (in a leaning position) of a prior art auto-balancing transportation device.

[0014] FIGS. 3-4 are a perspective view and a front elevation view (in a leaning position) of an auto-balancing transportation device in accordance with the present invention.

DETAILED DESCRIPTION

[0015] Referring to FIG. 3, an auto-balancing transportation device 110 in accordance with the present invention is shown. Similar to device 10, device 110 may include a wheel structure 120 with two tires 121,131, a first foot platform and a second foot platform 122,132, a motor (obscured from view) which drives the wheel structure, a position sensor 116 (which may be gyroscopic or other) and a control circuit 118. Wheel structure 120 may include rims 127,137 on which tires 121,131 are respectively mounted. Data from the position sensor is used by the control circuit to drive the motor towards dynamically self-balancing the device.

[0016] Device 110 solves the problem of the prior art by placing the pivot axes 141,142 of the foot platforms within wheel structure 120. In the embodiment of FIG. 3, axis 142 is placed within the envelope of tire 131. Axis 141 is similarly within the envelope of tire 121.

[0017] When device 110 is standing vertically on the ground, a vertical line from pivot axis 142 to the ground intersects tire 131 (and for axis 141, tire 121). Compared to the prior art, this configuration relocates the force applied to the pivot axis by the rider's weight. The location of the pivot axis inside the wheel envelope means that instead of the wheel structure experiencing the force of the rider's weight as downward torque originating from a point outside the wheel structure, the force is exerted upon the wheel structure at a point within the wheel structure. This allows the foot platform to remain fully unfolded during mount and dismount as shown in FIG. 4.

[0018] Platform mounting arms 161,162 connect the platforms 122,132 to their respective axes 141,142. In FIG. 4, it can be seen that arm 162 extends from inside the wheel structure to outside of it, and then angles downward to platform 132. The drop distance of arm 162 is preferably the distance axis 142 is within the wheel structure plus a buffer. The drop distance serves to further stabilize device 110 during mounting by placing platform 131 closer to the ground. This lessens the sideways tilt of the platform, making the device more stable and makes it easier to for a